(54) Title: RACKET HANDLE HAVING AN S-SHAPE
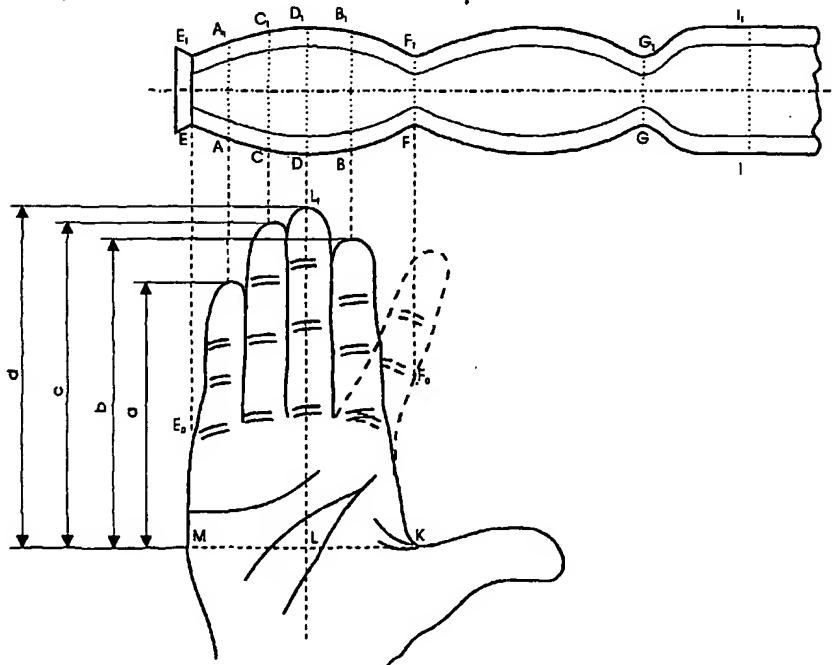
(57) Abstract: A racket handle having an S-shape is adapted to characteristics of a human hand: the circumferences of the outer
contour of the cross-section of the racket handle at positions AA1, BB1, CC1 and DD1 (shown in Fig. 2) are equal to one of the
values a, b, c and d, respectively (shown in Fig. 1). The circumferences at position FF1 is equal to the circumference at position EE1.

RACKET HANDLE HAVING AN S-SHAPE

Field of the invention

This invention relates generally to the field of tools and sport equipment's, especially to the field of game rackets and, more particularly to the handles thereof.

Technical problem

This invention solves the problem of the optimization of the shape of a racket handle taking into account both anatomical and physiological characteristics of the human hand.
Namely, it is obvious that the efficient holding and shaking of a racket are enabling proper control of a racket and accuracy of a stroke. The size, shape and the quality of a contact surface between the human hand and a racket handle are the critical parameters that determine efficiency of a racket holding and shaking. The more the contact surfaces the greater the efficiency of a racket control and the higher accuracy of a stroke. So, optimization of the shape and the size of the contact surface between the human hand and the racket handle lead to the optimization of the racket control. Both of these parameters must be adapted to conform optimally to the anatomical and natural physiological characteristics of the human hand.

State of the technique

Common tennis racket or the like has a handle with an octagonal cross-section whose longest faces are parallel to the racket face and with plastic cap at the butt. The contact surface between conventional racket handle and the human hand consists of flat faces. Despite numerous patented novelties and a certain improvement that has been realized (see U.S. Pat. No. 5,058,902 for details), neither improved solutions nor conventional straight grip do not optimally conform to the anatomical and physiological characteristics of the human hand. Namely, the solutions prevent the racket from being held and shacked most efficiently and do not enable optimal control of a racket.

Summary of the invention

It is the primary object of this invention to provide an optimal shape of the contact surface between a tennis racket handle and human hand that is optimally adapted to conform anatomic and natural physiological characteristics of the human hand. It is evident that the forefingers of a human hand have different lengths and that the central part of the user's palm has the recess, so the most efficient user's finger encircling of the handle is possible only if the thickness of the handle is not uniform along its length. Namely, the contact surface between racket handle and the human hand is the best optimized if the thickness of the handle is minimal in the region where the little finger and the edge zone of the palm (laying in extension of the little finger) are positioned and maximal in the region where the middle finger and the central part of the palm are positioned. In the regions where the ring finger and the index finger are positioned, the thickness

of the handle must be larger than in the region where the little finger is positioned and smaller than the thickness in the region where the middle finger is positioned. The such shape of the contact surface between the racket handle and the human hand (which I will call "S"-shape) has the characteristic that it lies uniformly against different grip regions and is best adapted for simultaneously supporting the user's fisted hand. For two hand players it is necessary the existing of two almost identical "S"-shaped parts of the same size (making one totality) that are adapted for being encircled and grasped by both user's hands. The only small difference exists at the very beginning of the first "S"-shaped part (position EE_1 in Fig. 2) where there is no need for the concave transition region from one part to another existing in the vicinity of the position FF_1 in Fig. 2. For one-hand players only the one "S"-shaped part of a racket handle is necessary, while the rest of the handle can have arbitrary shaped outer contour of any cross-section of a racket handle.

The thinnest portion of the racket "S" handle is arranged for supporting the user's little finger encircling and the edge zone of the user's palm encircling, lying in the extension of the little finger. The thickest portion of the racket "S" handle is arranged for supporting the user's encircling middle finger and the central part of user's palm encircling the racket "S" handle. The thickness of the region arranged for supporting the user's encircling of the index finger and the thumb is greater that the above-mentioned thinnest region and smaller than the above-mentioned thickest region. Such harmoniously curved "S"-shape of the racket handle is realizable for any outer contour of a cross-section type of a racket handle. The length and variable thickness of each above-mentioned part depend of the size of the user's hand and are different for various grip sizes. An exact optimization for every human hand is possible and the corresponding procedure is described in details here. A suitable tool for realization of that optimization is subject of a separate invention.

Brief description of the drawings

Fig. 1 represents a plan view of the palmer side of a human hand

Fig. 2 represents a plan view of the tennis racket "S" handles for players playing with two hands

Fig. 3 represents a plan view of the tennis racket "S" handles for players playing with one hand

Fig. 4 represents the outer contour of the conventional tennis racket handle cross-section.

Fig. 5 represents a perspective view of the tennis racket "S" handle with octagonal flat faces

Detailed description of the invention

In accordance with Fig.1 and demand that the contact surface between racket handle and the human hand must be as large as possible, the "S" handle has varying thickness along its length, shown in Fig. 2. The thickness variation is synchronized in accordance both with the length

variation of the forefingers of the human hand and palm recess. Namely, as shown in Fig. 2, the thickness of the racket "S" handle is continuously varying from the minimal thickness in the region where the little finger and the edge zone of the user's palm (laying in extension of the little finger) are positioned (position AA_1 in Fig. 2) to the maximal thickness in the region where the middle finger and the central part of the user's palm are positioned (position DD_1 in Fig. 2). Thickness of the racket "S" handle in the region where the index finger and the thumb are positioned (position BB_1 in Fig. 2) is smaller than its thickness in the region where the middle finger and the central part of the palm are positioned (position DD_1 in Fig. 2) and larger than its thickness in the region where the little finger and the edge zone of the palm laying in the extension of the little finger are positioned (position AA_1 in Fig. 2).

The procedure to determine the exact shape of the racket "S" handles is as follows:

The first step is to record the palmer side of an open human hand with outstretched forefingers and open thumb. First frame should be recorded with index finger in the neutral position (full line in Fig. 1) and than on the same frame should be recorded the same hand position changing only the position of the index finger by its moving in the maximal aside position (shown with broken line in Fig. 1). All next steps should be done on the resulting figure. The second step is to determine on the resulting figure (Fig. 1) the along axes of the middle finger (broken line LL_1 in Fig. 1). The third step is to determine the line (broken line KM in Fig. 1) that is normal to the along axes of the middle finger and that contains the bordering point of the open thumb and the palm (point K in Fig. 1). The fourth step is to measure the normal distances from the fingertips to that line (line KM in Fig. 1) in order to determine the lengths a, b, c and d, shown in Fig. 1. The fifths step is to put the line from the very outer bordering point of the edge zone of the palm and the little finger (point E_0 in Fig. 1) that is parallel to the along axes of the middle finger, in order to determine the position of the beginning of the buttcap (position EE_1 in Fig. 2). The length a (the normal distance from the little fingertip to the line KM in Fig. 1) is equal to the circumference of the outer contour of the cross-section of the racket "S" handles at the position of the little fingertip (position AA_1 in Fig. 2). The length b (the normal distance from the index fingertip to the line KM in Fig. 1) is equal to the circumference of the outer contour of the cross-section of the racket "S" handles at the position of the index fingertip (position BB_1 in Fig. 2). The length c (the normal distance from the ring fingertip to the line KM in Fig. 1) is equal to the circumference of the outer contour of the cross-section of the racket "S" handles at the position of the ring fingertip (position CC_1 in Fig. 2). The length d (the normal distance from the middle fingertip to the line KM in Fig. 1) is equal to the circumference of the cross-section of the outer contour of the racket "S" handles at the position of the middle fingertip (position DD_1 in Fig. 2). The next step is to determine the position of the very end of the part of the racket "S" handles (position FF_1 in Fig. 2) that is suited for one user's hand (part EFF_1E_1 in Fig. 2). First it should be determined the position of the very outer point of the second joint of the index finger that is maximal aside open (point F_0 in Fig. 1). Through the point F_0 one can putt the line that is parallel to the along axes of the middle finger (line LL_1 in Fig. 1) in order to determine the position where the circumference of the outer contour of the cross-section of the racket "S" handles (position FF_1 in Fig. 2) is equal to the circumference of the outer contour of the cross-section of the racket "S" handles at the position of the beginning of the buttcap (position EE_1 in Fig. 2). The circumferences of the outer contours of the cross-sections of the racket "S" handles at the positions AA_1, CC_1, DD_1 and BB_1 can be calculated by using a simple mathematical procedure,

that is specific for every type of an outer contour of a corresponding cross-section. The outer contour of the cross-section of the racket "S" handles can be arbitrary. Knowing that the circumferences of the outer contour of the cross-section of the racket "S" handles at positions AA_1, CC_1, DD_1 and BB_1 (shown in Fig. 2) are equal to one of the values a, b, c and d, respectively, one can fit a wanted (or predetermined) ratio (between the widths of the octagon faces, in the case of the octagonal outer contour of the cross-section shown in Fig. 4) in order to fulfill the above-mentioned demand of equality. The same procedure can be applied for every other type of an outer contour of the racket "S" handle cross-section. At all other positions between the positions EE_1 and FF_1 (including that positions), the values of the circumferences of the outer contours of the corresponding cross-sections of the racket "S" handles can be determined by best-fitting procedure applying the demand that the corresponding circumferences should be changing smoothly from one position to the next. Depending on the type of the outer contour of the cross-section of a racket handle, the best-fit calculation can be performed under assumption of the smoothly changing of the thickness of the racket "S" handles along its axes.

The second part of the racket "S" handle FGG_1F_1 (in Fig. 2) must be the same as the first part EFF_1E_1 and is suited for the user's second hand. The only small difference exists at the very beginning of the second part (FGG_1F_1 in Fig. 2) where the small concave part in the vicinity of the position FF_1 in Fig. 2 does not exist in the vicinity of the position EE_1 in Fig. 2. The rest of the racket "S" handle can have the cross-section with arbitrary outer contour (at position II_1 in Fig. 2 is shown conventional octagonal cross-section).

For the players playing only with one hand, the "S"-shape of the racket handle is necessary only for the first part of the racket handle, as it is shown in Fig. 3. The rest of the racket "S" handle can have either conventional octagonal outer contour of the cross-section (position JJ_1 in Fig. 3) or any other arbitrary outer contour of the cross-section. .

A perspective view of the tennis racket "S" handles with octagonal flat faces is shown in Fig. 5.

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Patent claims

1. A racket "S" handle having "S"-shaped thickness varying along the handle in accordance with the forefinger length variation and palm recess, arranged for being encircled and grasped either by one user's hand or by two user's hands.

2. The racket "S" handle according to the claim 1, wherein the racket "S" handle arranged for being encircled and grasped by one user's hand, have one "S"-shaped part suited for one-hand players.

3. The racket "S" handle according to the claim 1, wherein the racket "S" handle arranged for being encircled and grasped by two user's hands, have two "S"-shaped parts suited for two hand players.

4. The racket "S" handle according to the claim 1, wherein its minimal thickness is located both at the positions of the buttcap beginning and at the beginning and ending of the S-shaped parts.

5. The racket "S" handle according to the claim 1, wherein the normal distance between the position of the buttcap beginning and the maximal thickness of the racket "S" handle is equal to the normal distance between the bordering point of the edge zone of the user's palm and the user's little finger and the along axes of the middle finger (all measured in the plan view of the palmer side of the human hand).

6. The racket "S" handle according to the claim 1, wherein the circumference of the outer contour of the cross-section at the position of the maximal thickness of the racket "S" handle is equal to the normal distance between the middle finger-tip and the line containing the bordering point of the opened thumb and the palm and that is normal to the middle finger along axes (all measured in the plan view of the palmer side of the human hand).

7. The racket "S" handle according to the claim 1, wherein the circumference of the outer contour of the cross-section of the racket "S" handle at the position whose normal distance from the position of the buttcap beginning is equal to the normal distance between the bordering point of the edge zone of the user's palm and the user's little finger and the along axes of the user's little finger, is equal to the normal distance between the little finger-tip and the line containing the bordering point of the open thumb and the palm and that is normal to the middle finger along axes (all measured in the plan view of the palmer side of the human hand).

8. The racket "S" handle according to the claim 1, wherein the circumference of the cross-section of the racket "S" handle at the position whose normal distance from the position of the buttcap beginning is equal to the normal distance between the bordering point of the edge zone of the user's palm and the user's little finger and the along axes of the user's ring finger, is equal to the normal distance between the ring finger-tip and the line containing the bordering point of the open thumb and the palm and that is normal to the middle finger along axes (all measured in the plan view of the palmer side of the human hand).

9. The racket "S" handle according to the claim 1, wherein the circumference of the cross-section of the racket "S" handle at the position whose normal distance from the position of the buttcap beginning is equal to the normal distance between the bordering point of the edge zone of the user's palm and the user's little finger and the along axes of the user's index finger, is equal to the normal distance between the index finger-tip and the line containing the

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bordering point of the open thumb and the palm and that is normal to the middle finger along axes (all measured in the plan view of the palmer side of the human hand).

10. The racket "S" handle according to the claim 1, wherein the circumference of the cross-section of the racket "S" handle at the position whose normal distance from the position of the buttcap beginning is equal to the normal distance between the bordering point of the edge zone of the user's palm and the and the user's little finger and the very outer point of the second joint of the maximal aside open index finger, is equal to the circumference of the cross-section at the position of the buttcap beginning (all measured in the plan view of the palmer side of the human hand).

11. The racket "S" handle according to the claim 1, whose circumference of the outer contour of any cross-section that is not mentioned in the claims 6, 7, 8, 9, and 10, excluding the cross-section at the position of the buttcap beginning, is the result of the best-fit under assumption of the smoothly changing of the circumferences of the outer contours of the cross-sections that are mentioned in the claims 6, 7, 8, 9 and 10 (all measured in the plan view of the palmer side of the human hand).
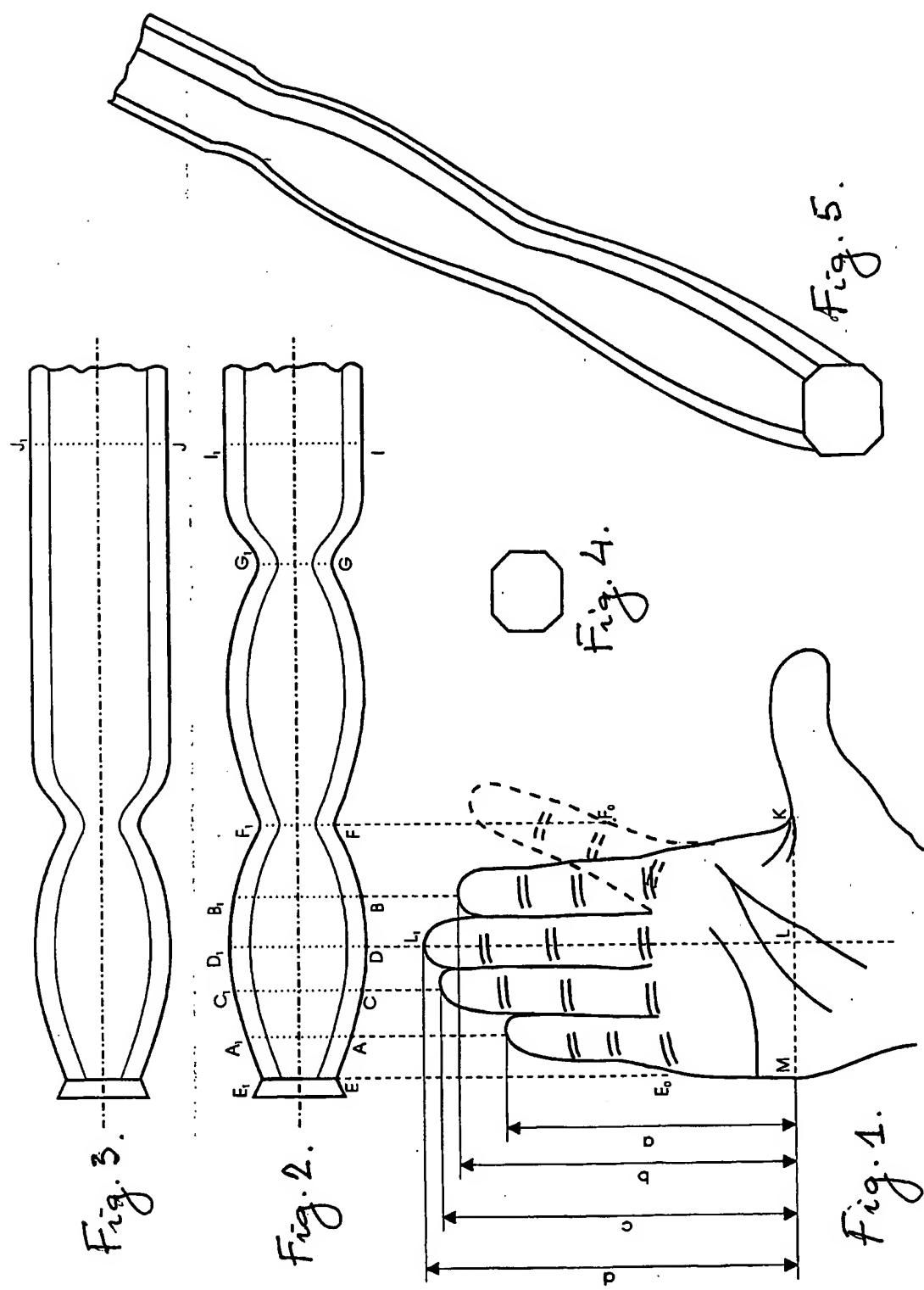
Fig. 5.

Fig. 4.

Fig. 3.

Fig. 2.

Fig. 1.

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   A63B49/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   A63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 36 28 618 A (BERGER IGNAZ) 19 November 1987 (1987-11-19) column 5, line 27 – line 36; figures ---	1-11
A	US 4 828 261 A (KLEYLEIN HORST) 9 May 1989 (1989-05-09) column 3, line 49 –column 4, line 17; figures 1,2 ---	1-11
A	DE 90 15 507 U (KLEYLEIN, HORST) 21 March 1991 (1991-03-21) the whole document -----	1-11

☐ Further documents are listed in the continuation of box C.   ☒ Patent family members are listed in annex.

° Special categories of cited documents :

'A' document defining the general state of the art which is not considered to be of particular relevance

'E' earlier document but published on or after the international filing date

'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

'O' document referring to an oral disclosure, use, exhibition or other means

'P' document published prior to the international filing date but later than the priority date claimed

'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

'X' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

'Y' document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

'&' document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 January 2004	30/01/2004

Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Authorized officer Fischer, E

Form PCT/ISA/210 (second sheet) (July 1992)

FURTHER INFORMATION CONTINUED FROM **PCT/ISA/** 210

Continuation of Box I.2

Claims Nos.: 1-11(partially)

Present claims 1-11 relate to a racket handle which is defined with
respect to a user's hand. The fact that due to different human anatomy
the hand may vary in a very large range is considered to lead to a lack
of clarity within the meaning of Article 6 PCT. It is impossible to
compare the definition the applicant has chosen to employ for the racket
handle with what is set out in the prior art. The lack of clarity is such
as to render a meaningful complete search impossible.

Consequently, the search has been restricted to the parts relating to a
method of determining the shape of a racket handle as mentioned in the
description at page 3, lines 11 to 42.

The applicant's attention is drawn to the fact that claims, or parts of
claims, relating to inventions in respect of which no international
search report has been established need not be the subject of an
international preliminary examination (Rule 66.1(e) PCT). The applicant
is advised that the EPO policy when acting as an International
Preliminary Examining Authority is normally not to carry out a
preliminary examination on matter which has not been searched. This is
the case irrespective of whether or not the claims are amended following
receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/YU 03/00019

Box I   Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.:   1-11(partially)
   because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

   see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II   Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest   ☐ The additional search fees were accompanied by the applicant's protest.

          ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Patent document cited in search report.		Publication date	Patent family member(s)		Publication date
DE 3628618	A	19-11-1987	DE	3628618 A1	19-11-1987
			DE	8608907 U1	17-07-1986
US 4828261	A	09-05-1989	DE	3414293 A1	24-10-1985
			WO	8504592 A1	24-10-1985
			EP	0179080 A1	30-04-1986
			JP	61501824 T	28-08-1986
DE 9015507	U	21-03-1991	DE	9015507 U1	21-03-1991